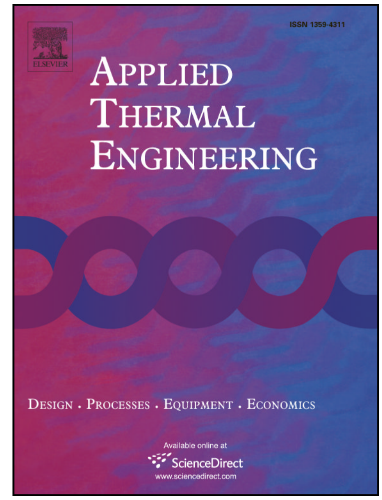
Accepted Manuscript



Topology optimization of conductive heat transfer devices: An experimental investigation

V. Subramaniam, T. Dbouk, J.-L. Harion

PII: S1359-4311(17)36150-1
DOI: https://doi.org/10.1016/j.applthermaleng.2017.12.026
Reference: ATE 11547

To appear in: *Applied Thermal Engineering*

Received Date: 22 September 2017
Accepted Date: 6 December 2017

Topology optimization of conductive heat transfer devices: An experimental investigation

V. SUBRAMANIAM[a,b], T. DBOUK[a,b,*], J.-L. HARION[a,b]

[a] *IMT Lille Douai, Industrial Energy Engineering Department, F-59500 Douai, France*
[b] *University of Lille, F-59000 Lille, France*

Abstract

For optimal tree-like heat conductive structures obtained numerically by topology optimization (TO), few experimental investigations exist in the literature to author's knowledge. In this context, the present study deals with an experimental investigation of tree-like structures obtained by topology optimization (known also by bi-material volume-to-point problems). For a volume (of lower conductivity material) that is continuously generating heat, TO predicts tree-like structures (of higher conductivity material) to evacuate efficiently the amount of heat being generated. Experimental measurements were carried out on two tree-like structures using infrared thermography in order to test the validity of the developed numerical topology optimization approach. It is found that the experimental thermal measurements are in good agreement with numerical data obtained by TO, which was developed in this work by coupling the method of moving asymptotes (MMA) as optimization algorithm to the solid isotropic material with penalization (SIMP) as a bi-material distribution technique.

Keywords: Topology optimization, heat conduction, volume-to-point problem, infrared thermography, method of moving asymptotes, solid isotropic material with penalization (SIMP)

Nomenclature

Greek Symbols

Symbol	Description	Unit
α	Thermal diffusivity	$\mathrm{m}^2 \cdot \mathrm{s}^{-1}$
γ	Ratio of thermal diffusivity	−
$\Delta x,\ \Delta y$	Mesh size	mm
ε	Convergence criterion	−
θ	Field of view	$^\circ$(deg)
ρ	Density	$\mathrm{kg} \cdot \mathrm{m}^{-3}$
σ	Standard deviation	−
ϕ_{max}	Maximum volume fraction	%

*Corresponding author
Email address: talib.dbouk@imt-lille-douai.fr (T. DBOUK)